

**TITLE OF THE INVENTION**

ELECTRICALLY SMALL PLANAR UWB ANTENNA APPARATUS AND RELATED SYSTEM

**CROSS-REFERENCE TO RELATED PATENT DOCUMENTS**

[001] This application is a continuation-in-part of U.S. Patent Application Serial No. 09/633,815, filed August 7, 2000, and entitled "Electrically Small Planar UWB Antenna Apparatus and System Thereof, which is related to U.S. Patent Application Serial No. ~~09/209,460~~ 6,700,939 filed on December 11, 1998 and entitled "Ultra Wide Bandwidth Spread-Spectrum Communications System," both of which are incorporated herein by reference in their entirety.

**BACKGROUND OF THE INVENTION**

[002] The present invention relates generally to antenna apparatuses and systems, and more particularly, to planar antennas with non-dispersive, ultra wide bandwidth (UWB) characteristics.

[003] With respect to the antenna of radar and communications systems, there are five principle characteristics relative to the size of the antenna: the radiated pattern in space versus frequency, the efficiency versus frequency, the input impedance versus frequency, and the dispersion. Typically, antennas operate with only a few percent bandwidth, and bandwidth is defined to be a contiguous band of frequencies in which the VSWR (voltage standing wave ratio) is below 2:1. In contrast, ultra wide bandwidth (UWB) antennas provide significantly greater bandwidth than the few percent found in conventional antennas, and exhibit low dispersion. For example, as discussed in Lee